

CLAIMS

What is claimed is:

1. An adaptive supply voltage and body bias apparatus comprising:
a master controller including an operation state value;
a dynamic voltage supplier operably coupled to the master controller, the dynamic voltage supplier operative to receive a supply voltage indicator;
an adaptive body biaseer operably coupled to the master controller, the adaptive body biaseer operative to receive a body bias indicator; and
a plurality of computing devices, each of the computing devices having one of a plurality of threshold voltages, the plurality of computing devices operative to receive a supply voltage from the dynamic voltage supplier and a bias voltage from the adaptive body biaseer.
2. The adaptive supply voltage and body bias apparatus of claim 1 further comprising:
a frequency monitor operably coupleable to the plurality of computing devices, the frequency monitor operative to receive an output frequency indicator from at least one of the plurality of computing devices.
3. The adaptive supply voltage and body bias apparatus of claim 2 wherein the frequency monitor generates a frequency offset value.
4. The adaptive supply voltage and body bias apparatus of claim 3 wherein the frequency offset value is based on a comparison of the output frequency indicator and a reference frequency indicator.

5. The adaptive supply voltage and body bias apparatus of claim 3 wherein the frequency offset value is provided to the master controller, the master controller generating a second supply voltage indicator and a second body bias indicator in response to the frequency offset value and the operation state value, the master controller operative to provide the second supply voltage indicator to the dynamic voltage supplier and operative to provide the second body bias indicator to the adaptive body bias circuit.

6. The adaptive supply voltage and body bias apparatus of claim 5 further comprising:

the plurality of computing devices operative to receive a second supply voltage from the dynamic voltage supplier and a second bias voltage from the adaptive body biaser.

7. The adaptive supply voltage and body bias apparatus of claim 1 wherein the master controller receives the operation state value from a processing device.

8. The adaptive supply voltage and body bias apparatus of claim 1 wherein the plurality of computing devices are disposed on a processing element.

9. The adaptive supply voltage and body bias apparatus of claim 1 wherein the supply voltage indicator and the body bias indicator are voltages.

10. A method for adaptive supply voltage and body bias, the method comprising:
generating a supply voltage indicator and a body bias indicator in response to an operation state value;
generating a supply voltage in response to the supply voltage indicator;
generating a body bias voltage in response to the body bias indicator; and
providing the supply voltage and the body bias voltage to a plurality of computing devices, each of the computing devices having one of a plurality of threshold voltages.
11. The method of claim 10 further comprising:
generating an output frequency from at least one of the plurality of computing devices;
providing the output frequency to a frequency monitor; and
generating a frequency offset value based on the output frequency and a reference frequency.
12. The method of claim 11 further comprising:
providing the frequency offset value to a master controller;
generating a second supply voltage indicator and a second body bias indicator in response to the frequency offset value and the operation state value; and
providing the second supply voltage indicator to a dynamic voltage supplier and the second body bias indicator to an adaptive body biaser.
13. The method of claim 12 further comprising:
generating a second supply voltage;
generating a second body bias voltage; and

providing the second supply voltage and the second body bias voltage to the plurality of computing devices.

14. The method of claim 10 further comprising:

receiving the operation state value from a processing device.

15. The method of claim 10 wherein the plurality of computing devices are disposed on a processing element.

16. An adaptive supply voltage and body bias apparatus comprising:
- a master controller operative to receive an operation state value, the master controller operative to generate a supply voltage indicator and a body bias indicator based on the operation state value;
 - a dynamic voltage supplier operably coupled to the master controller, the dynamic voltage supplier operative to receive the supply voltage indicator;
 - an adaptive body biaser operably coupled to the master controller, the adaptive body biaser operative to receive the body bias indicator;
 - a plurality of computing devices, each of the computing devices having one of a plurality of threshold voltages, the plurality of computing devices operative to receive a supply voltage from the dynamic voltage supplier and a bias voltage from the adaptive body biaser;
 - a frequency monitor operably coupleable to the plurality of computing devices, the frequency monitor operative to receive an output frequency indicator at least one of the plurality of computing devices.
17. The adaptive supply voltage and body bias apparatus of claim 16 wherein the frequency monitor generates a frequency offset value based on a comparison of the output frequency indicator and a reference frequency indicator.
18. The adaptive supply voltage and body bias apparatus of claim 17 wherein the frequency offset value is provided to the master controller, the master controller generating a second supply voltage indicator and a second body bias indicator in response to the frequency offset value and the operation state value, the master controller operative to provide the second

supply voltage indicator to the dynamic voltage supplier and operative to provide the second body bias indicator to the adaptive body bias circuit.

19. The adaptive supply voltage and body bias apparatus of claim 18 further comprising:

the plurality of computing devices operative to receive a second supply voltage from the dynamic voltage supplier and a second bias voltage from the adaptive body biaser.

20. A method for tuning a supply voltage and a body bias for a processing device, the method comprising:

for a first sub-section of the processing device:

- (a) generating a supply voltage indicator and a body bias indicator in response to an operation state value;
- (b) generating a supply voltage in response to the supply voltage indicator;
- (c) generating a body bias voltage in response to the body bias indicator;
- (d) providing the supply voltage and the body bias voltage to a plurality of computing devices, each of the computing devices having one of a plurality of threshold voltages;
- (e) generating an output frequency with at least one of the plurality of computing devices;
- (f) generating a frequency offset value based on the output frequency and a reference frequency; and
- (e) updating the supply voltage and the body bias voltage in response to the frequency offset value and the operation state value.

21. The method of claim 20 further comprising:

dividing the processing device into a plurality of sub-sections, wherein each sub-section includes the plurality of computing devices, each of the plurality of computing devices have one of a plurality of threshold voltages.

22. The method of claim 21 further comprising:

repeating steps (a) through (e) for each of a plurality of sub-sections of the processing device.

23. The method of claim 22 wherein the operating state value may be one of a plurality of values for each of the sub-sections.